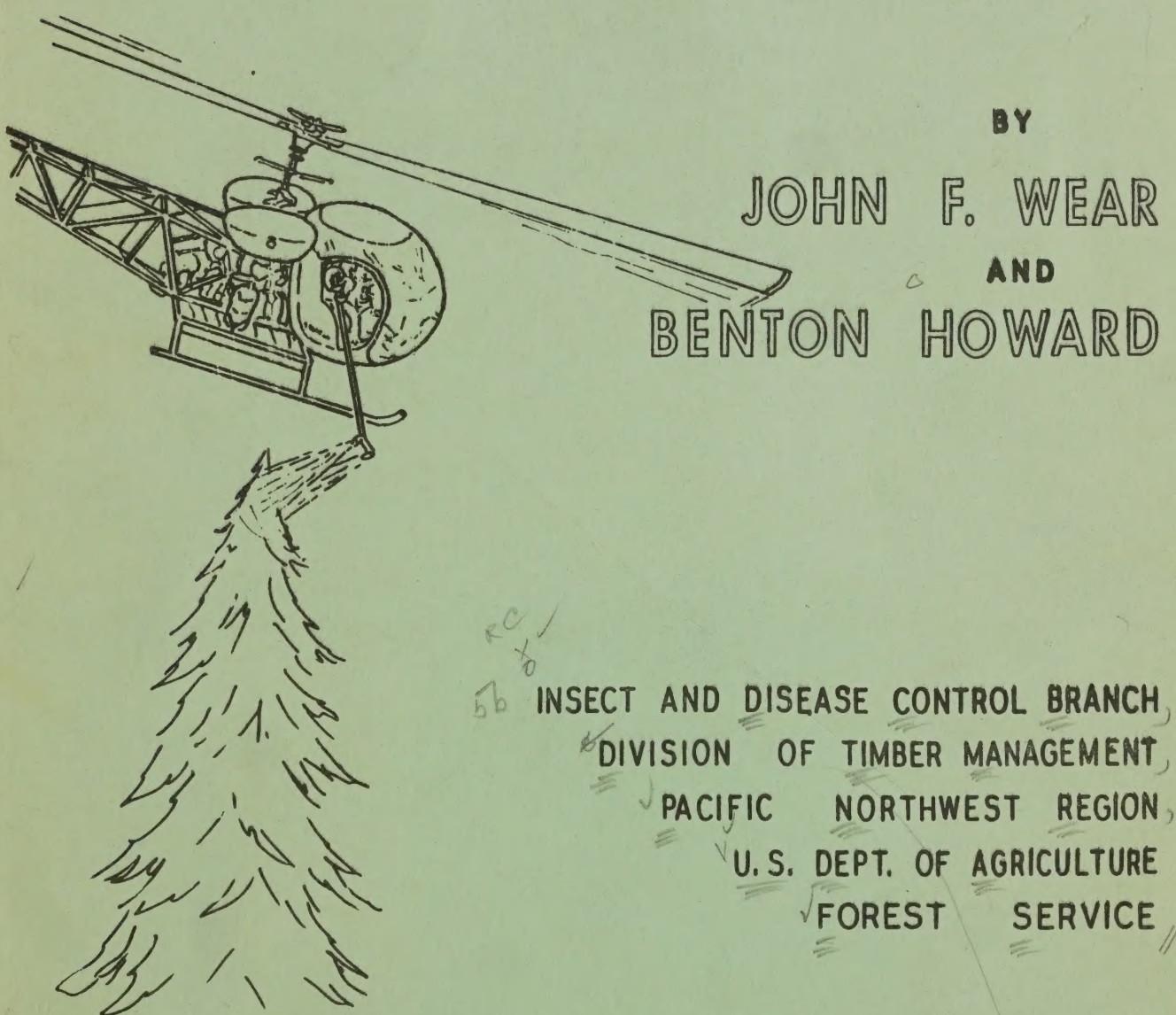


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NEW TREE MARKING SYSTEM IMPROVES FOREST SPRAYING OPERATIONS



BY

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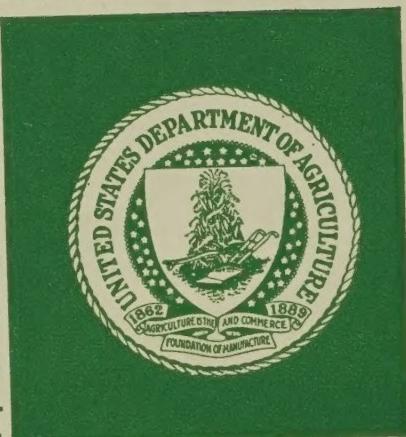
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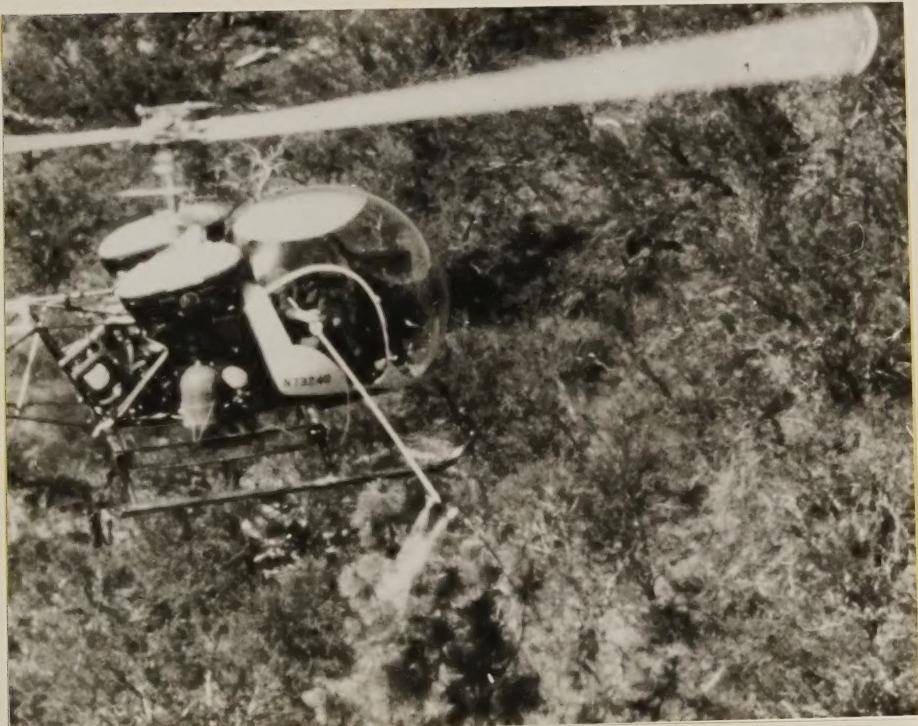
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Spray painting a treetop for an insect control operation.

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I. SUMMARY

Tree marking systems using a helicopter have been developed by the U. S. Forest Service to improve aerial spraying operations over forested areas. The application of either a highly reflective paint or a weighted streamer to the top of a dominant tree results in a boundary marker or spray plot marker that a pilot can see for about a mile or more, terrain permitting. No longer does aerial spraying need to be inconsistent and inefficient on critical spray areas because of inadequate or poor references for pilot orientation.

The Insect and Disease Control Branch, Division of Timber Management, Region 6, U. S. Forest Service, has the responsibility to control forest insect outbreaks by direct control methods when justified and to improve aerial spraying techniques.

Several aerial marking devices and procedures were designed and tested. Of the several methods tested, two that can be applied by helicopter are feasible. Each type marker lasts several weeks and usually longer under favorable weather conditions. Many treetops can be marked in a short time compared with marking by time-consuming ground methods.

II. INTRODUCTION

Reports of previous spray projects show that spray strips are occasionally missed, adjacent non-spray areas are contaminated, or spray materials are so unevenly distributed within spray blocks that respraying may be required. A good tree marking method for forest areas and mountainous terrain has been needed to accurately delineate forest spray strips and blocks or plot boundaries for good coverage. A second need has been to minimize contamination of non-spray areas such as streams and meadows due to pilot error.

Both ground and aerial approaches to tree marking have been tried with varying success in past years. The structure of the forest stand, whether even-age or uneven-age or open stocking or dense stocking, determines the tree marking or boundary marking techniques. Dense, even-age stands (trees of the same relative height) may require an aerial tree marking technique. Tree markers in open, uneven-age stands can be applied feasibly either from the ground or from the air.

The most common method for marking trees from the ground is to attach a white or colored flag or cloth panel either vertically or horizontally in the tree canopy. The taller the tree the more difficult it is to install a satisfactory tree marker from the ground. It is laborious, time consuming and costly to send a tree climber to the top of a tall tree. Another ground technique is to shoot a small projectile attached to a heavy cord over the treetop and then to pull a cloth marker into the tree crown. Using the same method, a quart of paint in a cardboard container and a detonator can be pulled into the treetop. When the container

is exploded, the foliage in the treetop is covered with paint. Either an aluminum or fluorescent paint makes a good marker. Some needles are lost, but this tree marker is visible for more than one-half mile. However, the transporting of bulky equipment and tree marking materials over rough, brushy and frequently inaccessible terrain has emphasized the need for more efficient tree marking techniques.

III. PROCEDURES

The helicopter, which has safe, slow flying and hovering capabilities provides a means of marking trees from the air. The type of helicopter to be used depends upon the elevation above sea level where trees are to be marked and the problems imposed by mountainous terrain. Helicopter performance and hovering capabilities for marking trees must be adequate to work safely at the specific altitude of the area. Helicopter pilots must be qualified in hovering tactics and be fully experienced in mountain flying.

Both individual tree markers and boundary line strip markers are needed; one to identify a corner of a spray plot or the junction of several spray blocks, and one to identify boundaries of large plots or irregularly shaped blocks. Basic requirements for tree markers are to be visible from several directions for distances of approximately one mile, terrain permitting, and to have a minimum duration of at least two or three days and if possible, with a life expectancy of up to one month or more.

One of the two tree marking methods found satisfactory was treetop painting. Two treetop painting techniques, one where a passenger applies the paint and one where the pilot applies the paint are satisfactory procedures.



Method 1.--The passenger in the helicopter uses a seven-foot wand with a shutoff valve to spray paint a treetop. Two nozzles (angled inward) are attached to a one-foot pipe on the end of the wand. The helicopter hovers about six feet above and along one side of a tree while the passenger applies the paint.

John F. Wear holds lightweight spray wand.
Five-gallon spray tank is on litter platform.

Method 1a.--Because of the excellent forward visibility from the helicopter a spray wand can be mounted on the front of the helicopter to enable the pilot to mark the tree. The wand is mounted to a bar placed across the tips of the helicopter skids and extends about eight feet beyond the skids. A two-foot pipe is attached at right angles to the end of the wand. On it are mounted three evenly spaced nozzles (the two outside nozzles tilted inward). Since the fluorescent paint has the consistency of thick cream, the nozzle size should be equivalent to Chicago Spraying System #10.



Helicopter pilot applies paint to Douglas-fir top using wand mounted on bar across helicopter skids.

The pilot does the spraying by maneuvering the helicopter into the proper position above the tree and engaging an electrical switch to the spray pump. It is necessary for the pilot to position the spray wand tip about one foot past the treetop because helicopter rotor blast forces the spray paint backward toward the helicopter. The pilot must consider the prevailing wind and terrain features in order to approach the tree safely. When about ten feet from the tree, the helicopter is slowly maneuvered to a level of about one foot above the treetop. This level is maintained until the spray wand tip is just beyond the treetop while the tree is being painted.

The small amount of fluorescent paint (one pint) covers the top three or four feet of the tree crown and is visible for about one mile. When many trees are to be marked, a paint spraying system consisting of a ten- to fifteen-gallon tank and an electrically driven pump with the essential tubing and hoses is attached to the litter platform of the helicopter. When only a few trees are to be marked, a smaller three- to five-gallon low-pressure air tank and accessories are satisfactory. Two gallons of paint at 70 pounds initial air pressure will mark about 16 trees (one pint per tree). The air tank can be strapped to the helicopter's litter or it can be placed on the cabin floor.

For painting treetops special mixtures of high-visibility, water soluble, fluorescent-type paints were mixed by the General Paint Company Laboratory in Portland, Oregon. Red and yellow fluorescent paint and white water base paint were tested on individual ponderosa pine trees. The most visible was red, yellow next, and white poorest. Three colors in the red fluorescent range; i.e., orange, red and carmine-red, can be formulated for use in separating spray blocks or identifying individual spray plots.

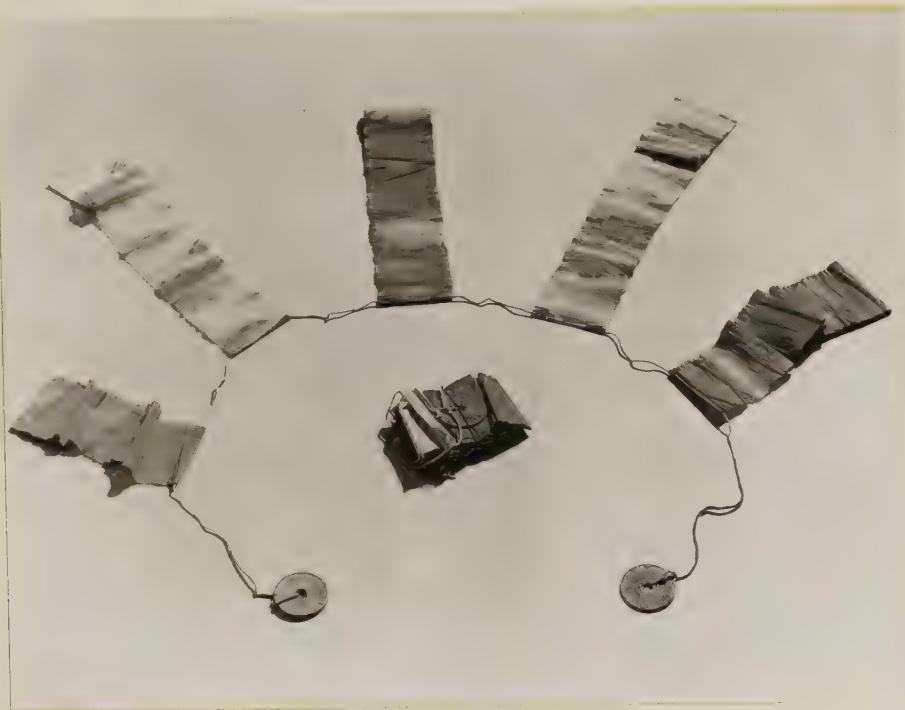


Nozzle arrangement for hand-held spray wand.



Spray tank with stand, paint filler and air pressure cap, pressure gauge, pressure relief valve, spray wand with hose connection and shutoff valve.

Method 2.--The other type of marker found to be effective is a crepe paper streamer that spreads into a treetop when thrown from a helicopter flown at low speed. However, this type of marker is not as visible as the red fluorescent paint marker. This type of marker is made of inexpensive materials, simple to assemble, and easy to throw from a helicopter. The marker consists of four to six crepe paper strips (five inches wide and five feet long). At intervals of about eight inches along a six-foot piece of heavy string, staple a paper strip. A heavy washer is attached to each end of the string. The long paper strips are accordian-folded into a five-inch by five-inch stack. Stacks are bundled together with a washer on each side and bound with a rubber band. This completes the packet assembly for the crepe paper tree marker.



Crepe paper marker showing arrangement of streamers along string and $2\frac{1}{2}$ inch washers. Folded packet in center is ready to deploy.

The marker is placed in the tree crown from the helicopter by holding one washer and the crepe paper packet between thumb and forefinger, the other washer between the third and fourth finger, and throwing the packet assembly laterally at the treetop. With a little practice, the marker can be thrown accurately from the helicopter so that the washers spread the string and paper strips. The weight of the washers help prevent the marker from being dislodged. The marker is hurled from about ten feet above the tree as the helicopter flies at a speed of

15 to 20 m.p.h. The bright red, yellow, and orange colored crepe paper streamers can be seen readily for about one-half mile. Additional attention is drawn to the marker whenever the lightest breeze causes the streamers to flutter. Crepe paper is an efficient temporary marker but will generally fade in the sunlight and deteriorate rapidly with rain. Wide plastic tape in various bright colors could be fabricated into streamer markers which would have much greater resistance to weathering.

IV. RECOMMENDATIONS

These aerial tree marking techniques are highly effective for identifying an individual tree common to several spray blocks, trees at the corners of small spray plots, and trees at key positions in rough terrain. When specific trees are marked as plot corners, it is necessary for a man to be on the ground and identify the tree for the pilot. Radio communication is required.

The technique that was most effective for marking boundaries consisted of marking a series of individual trees in the forest canopy at close intervals along a specified line. The line may be between two landmarks or parallel to a stream bed or some other geographic or cultural feature. The spacing depends largely on the topography and the need for precision but as a general rule, trees should be marked every few chains for precision spraying of large experimental spray plots and at greater intervals for delineation of long block boundaries and non-spray areas. Fluorescent paint markers or crepe paper streamers should be applied to dominant or codominant trees at predetermined intervals along the line.

The number of trees to be marked is determined by the topographic, cultural and vegetative features such as meadows, openings, rocky outcrops, roads, ridges, streams, and other terrain characteristics that are normally used by the spray pilot for orientation on flight lines. The resource values to be protected from contamination or spray drift also determine the need for additional tree markers in certain instances. The greater the number of trees to be marked, the lower the proportionate cost per tree.

Many plot markers can be installed in a relatively short time and at a reasonable cost. The cost of helicopter tree marking for a spray project is variable from project to project and must be estimated for each one. Costs depend on the rental rate of the helicopter while ferrying to and from the area and while marking the trees, the total number of trees to be marked, the marking materials, the application equipment, and number of people involved.

When helicopters are to be used on a spray project, the same helicopters would usually qualify for marking trees. In this case, a minimum of ferry time would be involved. When a suitable helicopter is not available in the area, total ferry costs must be added. When the trees to be marked are within a mile or so of a helispot, approximately 40 trees can be marked in an hour by spray painting or 50 trees by weighted streamer.

The cost of marking materials for each tree is usually low, about \$1.25 per pint, \$10.00 per gallon in five-gallon lots of the fluorescent paint and \$0.45 for a weighted streamer (crepe paper, string, and two $2\frac{1}{2}$ inch washers). An assembled streamer costs about \$0.75.

The portable paint spraying equipment for the water soluble fluorescent paint ranges in cost from \$100.00 to \$175.00 depending on the size and type of spray unit. Least costly is the air pressure unit that includes a five-gallon air tank, shutoff valve, tubing and nozzles. A larger ten- to fifteen-gallon tank, electric gear pump, and the spray accessories, is more expensive but will carry sufficient paint to mark 80 to 100 trees. Because of the large number of variables in estimating tree marking costs, the tree marking program for each control operation will have to be estimated separately.

Spray pilots can readily refer to these boundary markers whether flying parallel or at right angles to the line of tree markers. Thus, spray blocks within forested areas can be covered adequately with an even distribution of spray materials and a minimum number of gaps, and without serious contamination of any non-spray areas or damage to other natural resources due to faulty flying patterns.

Availability of a suitable helicopter relatively close to the project may limit the use of this aerial tree marking system. However, on spray projects where tight control of aerial application is needed and other valuable resources require protection from contamination, adequate spray boundary delineation helps the spray pilots immeasurably and insures a better control operation. Experience shows that the cost of adequate plot and block boundary markers is often well justified.

